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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No.	350340800004
First Inventor or Application Identifier	Paul Metcalfe
Title	Coupling Assembly Having Enhanced Axial Tension Strength
Express Mail Label No.	EL098129185US

APPLICATION ELEMENTS
See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. [X] * Fee Transmittal Form (e.g., PTO/SB/17) (Submit an original and a duplicate for fee processing)
2. [X] Specification [Total Pages 17] (preferred arrangement set forth below)
   - Descriptive title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings (if filed)
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
3. [X] Drawing(s) (35 U.S.C. 113) [Total Sheets 4]
4. Oath or Declaration [Total Pages 2]
   a. [X] Newly executed (original or copy)
   b. [ ] Copy from a prior application (37 C.F.R. § 1.63(d)) (for continuation/divisional with Box 16 completed)
      i. [ ] DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

*NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

5. [ ] Microfiche Computer Program (Appendix)
6. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)
   a. [ ] Computer Readable Copy
   b. [ ] Paper Copy (identical to computer copy)
   c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. [X] Assignment Papers (cover sheet & document(s)) (5 pages)
8. [ ] 37 C.F.R.§3.73(b) Statement (when there is an assignee) [ ] Power of Attorney
9. [ ] English Translation Document (if applicable)
10. [X] Information Disclosure Statement (IDS)/PTO-1449 [X] Copies of IDS Citations 17 references
11. [ ] Preliminary Amendment
12. [X] Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
13. [ ] * Small Entity Statement(s) (PTO/SB/09-12) [ ] Statement filed in prior application, Status still proper and desired
14. [ ] Certified Copy of Priority Document(s) (if foreign priority is claimed)
15. [X] Other: Check

16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:
[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No: Priority claimed on 60/071,159
Prior application information: Examiner ______ Group / Art Unit: filed 1-12-98

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

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Signature	F. Drexel Feeling	Date	Jan. 12, 1999

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Title of the Invention

COUPLING ASSEMBLY HAVING ENHANCED AXIAL TENSION STRENGTH AND METHOD OF INSTALLATION OF COUPLED UNDERGROUND DUCT

Inventors

Paul Metcalfe, Craig Homberg, and Walter Lockard

COUPLING ASSEMBLY HAVING ENHANCED AXIAL TENSION STRENGTH AND METHOD OF INSTALLATION OF COUPLED UNDERGROUND DUCT

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

This application claims the benefit under 35 U.S.C. 119(e) of United States Provisional Application Serial No. 60/071,159 filed January 12, 1998.

The present invention provides a coupling assembly for plastic pipe, and more particularly a coupling assembly in which the coupled pipe has enhanced axial tension strength resulting in a pipe and coupling connection that can withstand high axial loads in tension, and that require no additional means for maintaining the coupling assembly in a coupled state. This coupling assembly is particularly useful in applications that require that multiple coupled lengths of pipe be pulled long distances through underground boreholes while maintaining a seal between the coupled lengths of pipe without disconnecting. The present invention provides an inexpensive plastic coupling assembly for conduit or pipe comprising a tubular component, a coupler, an annular locking strap, and an annular sealing member, the combination being easy to assemble and disassemble and allowing at least one thousand feet of such pipe to be pulled through an underground borehole without the use of additional fasteners to maintain the coupled state.

DESCRIPTION OF RELATED ART

Fiber optic transmission lines and other cables have increasingly replaced metallic electricity-conducting wires. For various reasons, it has been desirable to bury fiber optic cables, utility cables and utility pipes underground. To protect the cables and pipes while underground, the cables or pipes may be placed in a conduit or duct. See, e.g., U.S. Patent No. 5,027,864 to

Conti, et al. The cables may be placed in an inner duct, that, in turn, is pulled through a larger outer duct. See also U.S. Patent No. 5,087,153, to Washburn.

One preferred material for underground duct applications is PVC pipe or tubing, which is normally supplied in lengths of 4, 10 or 20 feet, but may be supplied in other lengths. Each such length of pipe must be coupled to adjacent lengths by means of a coupling assembly. A single 20 foot length of 4-inch PVC pipe weighs approximately 45 pounds. Thus, a tunnel one thousand feet long will require that some of the coupling assemblies bear an axial tensile force of at least several thousand pounds due to the combined effects of pipe weight, frictional drag resulting from the pipe walls contacting the walls of the borehole while the conduit is pulled, or contact with other obstructions. When this several thousand pounds is applied over the surface area contacted by a locking mechanism in a coupling assembly, the pressure borne by the locking portion of the coupling assembly may be close to the tensile strength of PVC. Previously known PVC coupling assemblies could not bear such loads, or required additional fasteners. Prior art augmentation of such coupling assemblies greatly increased the difficulty, expense and even danger of using coupled lengths of plastic pipe for such applications. Coupling assemblies made from other materials such as metal were unsatisfactory for reasons such as weight; limitations of the materials, such as the proneness to corrosion of some metals (e.g., aluminum or steel); or expense (e.g., stainless steel).

Continuous lengths of plastic tubing have been used for underground duct applications. The method for installing this type of conduit into a horizontal borehole is by pulling long lengths of the tubing from a spool through the borehole. The most often used plastic tubing is polyethylene ("PE"), supplied on large, heavy spools, each containing some 600 feet of tubing. Such tubing generally has a wall thickness of 0.320 inch in a four-inch diameter. While

inexpensive and widely available, PE tubing suffers from several drawbacks. Adjacent lengths must be butt sealed together by appropriate welding with a specialized apparatus. Both the tensile strength and crush resistance of PE tubing are less than that of a material such as PVC pipe. Such tubing frequently suffers from increased ovality due to the flattening effect of being coiled on the spool. A contractor installing the tubing must feed each spool from a specially designed apparatus, upon which each spool must be mounted in turn. When the end of the spooled tubing is released, it can dangerously whip around, potentially causing serious injury to workers and others. In a related effect, PE has a considerable "memory" of the curvature it has been forced to adopt while on the spool, as a result of which the PE tubing retains a strong tendency to curl after it is removed from the spool. Finally, tubing is often wasted if the length of the borehole does not equal the length of a multiple number of spools of tubing.

PVC pipe lengths have several advantages over continuous lengths of coiled tubing. With PVC pipe, the exact number of lengths needed for a job can be stacked together and delivered in an ordinary flatbed truck minimizing time, manpower, equipment and wasted material. PVC pipe has greater tensile strength and crush resistance than polyethylene tubing, and has better resistance to developing ovality. Because the lengths have not been forced to bend prior to use, they do not suffer from "memory" problems found with PE tubing.

Use of PVC pipe has not been without disadvantages. Previously known PVC pipe couplings typically required augmentation. Thus, numerous steps were performed in prior art methods to assemble the coupled lengths of PVC pipe. One method requires cementing the joint together after it is assembled. The typical coupling for such PVC pipe is a bell and spigot type coupling, in which each length of pipe has one end slightly belled outward (the coupler) and the other end not belled (the tubular component). The belled end is enlarged to a degree sufficient to

allow a non-belled end of an adjacent length to enter, forming a sealed coupling when properly cemented together.

The cementing process includes all the known difficulties associated with PVC cement, including the use of noxious, hazardous solvents and the time required for the PVC cement to cure. The most serious drawback of this type of glued-together coupling for use in applications requiring installation by pulling through a substantially horizontal borehole is the lack of resistance to axially applied tension when in the coupled state. This drawback has only previously been overcome by augmenting the PVC cement with other fastening means, typically radially inserted screws. In order to securely attach the lengths together, screws such as self-tapping metal screws are inserted radially into the coupling assembly adding an additional step, equipment, and personnel. But, even with this improvement, additional time for the glue to cure is needed in advance of the time when the pipe is to be pulled through the tunnel. As a result, it is normally necessary to pre-assemble several hundred feet or the entire string of glued- and screwed-together PVC pipe, before the pulling process can be started.

An additional drawback of using bell and spigot coupling assemblies results from the diameter of the bell end, which is larger than the remainder of the pipe. This increased diameter makes the installation of the pipe through the underground borehole more difficult due to increase drag especially when rocks, roots, or other obstructions are encountered. The screw heads also increase the installation difficulties because they extend radially outwardly from the bell further increasing the outside diameter of this portion of the pipe and provide a location for encountering snags with obstructions.

The present invention provides a simpler, stronger, and easier to assemble coupling assembly than any known heretofore.

SUMMARY OF THE INVENTION

A major difficulty that must be overcome when pulling any duct through an underground borehole or other passage is the high axial tension the duct and its coupling assemblies must withstand. This is particularly true for lengths of duct held in the coupled state by known coupling assemblies. The present invention provides an inexpensive plastic coupling assembly for conduit or pipe, comprising a first coupling member, a second coupling member and a locking member. The first coupling member is optionally a tubular component and the second coupling member or coupler is optionally a belled component. The present invention is also optionally provided with an annular sealing member. The combination is easy to assemble and disassemble and allows at least one thousand feet of such pipe to be pulled through an underground borehole without the use of additional fasteners to maintain the coupled state. The coupling assembly may be assembled without the use of tools by manually inserting the tubular component into the coupler and then inserting the locking strap into a slot and into a locking strap passageway. The coupling assembly may be disassembled without the use of tools by performing the installation sequence in reversed order. When assembled, the locking strap is disposed in a locking position between the coupler and the tubular component and the annular sealing member is disposed in a sealing position between the coupler and the tubular component. The coupling assembly remains locked and sealed when subjected to high axial pulling forces. The coupling assembly of the present invention requires no augmentation to its strength for axial tension, the locking strap providing sufficient strength when in its locking position that no additional fasteners or glue are needed to maintain the coupling assembly in the coupled state.

The coupling assembly of the present invention further provides a smooth, obstruction-free inner surface and a relatively smooth outer surface. The outer surface is generally convex,

although it preferably has a central constant-diameter portion. The outside diameter of the coupler is only slightly greater than the diameter of the pipe or tubular component, and the outside diameter of the coupler tapers to a smaller diameter toward the end of the coupler. The coupling is therefore relatively smooth and avoids the possibility of snags or excessive frictional interactions with the walls of or obstructions within the borehole through which the pipe is installed.

The preferred coupler has an inner surface that includes a groove used in locking the coupling assembly together, a stop surface used to prevent over-insertion of the tubular component, and a groove for an annular seal.

The coupling assembly of the present invention further provides high strength against lateral forces tending to bend the coupling assembly and result in breakage of either the locking or sealing function. This strength derives from the depth of insertion of the tubular component into the coupler and from the strength of the materials of construction of the coupler, and the relative positions of the locking ring and sealing member. The method of the invention is simpler than previously known methods, due to the advantages of the present invention.

As will be appreciated, the invention is capable of other and different embodiments, and its several details are capable of modifications in various respect, all without departing from the spirit of the invention. Accordingly, the drawings and description of the preferred embodiment are to be regarded as illustrative in nature and not restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention satisfies the needs noted above as will become apparent from the following description when read in conjunction with the accompanying drawings wherein:

FIG. 1 is a view of a preferred conduit having the coupling elements that form the coupling assembly of the present invention.

FIG. 2 is a view of a preferred coupler component.

FIG. 3 is a view of a preferred locking key.

FIG. 4 is a view of a preferred sealing member.

FIG. 5 is a view of a preferred conduit assembly with an installed locking key.

FIG. 6 is a view of a preferred tubular component.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The following description is made with reference to the drawings. As shown in Figures 1-6, the preferred coupling assembly of the present invention includes a coupler **12**, a tubular component **14**, a locking key **16**, and an annular sealing member, such as annular sealing seal **18**. The coupling assembly is designed to assemble easily and by hand, but to strongly resist both high axial tension and high lateral stress.

The coupler **12** is formed at one end of a section of the tubing and has an inner surface **20**, an outer surface **22**, and a pipe wall **72**. The coupler **12** has a curved region **24** at which both the inner diameter ("ID") and the outer diameter ("OD") of the curved region **24** gradually increase until the inner diameter of curved region **24** exceeds the outer diameter of the tubular portion of the coupler **12**. Resistance to snags on roots and rocks is greater on the pipe coupling according to this invention due to the gradual transition of the coupler OD. The prior art coupling design offers no transition, but has a 90 degree edge that is from 0.5 to 0.75 inches high per side. The coupling of this invention makes a minor .25 inch transition over approximately 1.5 inches. The

inner surface **20** of the curved region **24** also provides a stop surface **70** to prevent over insertion of the tubular component **14**.

The curved region **24** terminates into a slightly tapered region **26**. The slighty tapered region **26** is provided with a seal groove **28** and a locking strap groove **30** on inner surface **20**. Seal groove **28** is shallow, approximately .07 to .08 inches, allowing for a thicker pipe wall **72** and the resultant increase in tensile strength of the pipe joint. This is critical because the seal groove **28** is one of the weakest areas of the pipe joint in pure tensile strength loading. Even with the thicker pipe wall, the OD of the coupler **12** can be made smaller, nominally 5.0 inches, compared to the competing coupled pipe design that are 5.5 or 6.0 inches in diameter. The reduced OD allows for the drilling of a smaller hole for installation of the pipe thus reducing installation cost based on reduced drilling time and labor.

The slightly tapered region **26** of the most preferred embodiment is at least approximately 6 inches in length that enables greater engagement and depth of overlap of the coupling **12** compared to the prior art devices. Engagement and depth of overlap of the pipe joints has direct impact on the strength of the joint while being bent. Analysis indicates that lower overlap results in a significant decrease in the ability of the joint to withstand bending. The competing design has only 4 inches of engagement of the pipe.

Coupler **12** is also provided with a slot **54** in region **26** that extend from outer surface **22** to locking strap groove **30** on inner surface **20**. Slot **54** is formed tangent to the centerline of locking strap groove **30**.

The tubular component **14** is formed at the other end of the tubing. The tubular component **14** has an inner surface **32** and an outer surface **34**. Outer surface **34** is provided with a locking strap recess **36**. Locking strap recess **36** is provided with a wider width than locking

strap groove **30** to provide an adjustability feature enabling the insertion of locking strap **16** without further positioning of tubular component **14** and coupler **12**. When the tubular component **14** is installed in coupler **12**, the locking strap recess **36** is opposite locking strap groove **30** to form locking strap passageway. The tubular component **14** is also provided with a beveled or chamfered end surface **38** adjacent the tube end **74**. The preferred tubular component **14** is constructed from a thermoplastic material.

The locking strap **16** is made of any plastic material possessing sufficient tensile strength to withstand the pressure exerted on the pipe such as nylon and includes a handle portion **40** and a body portion **42**. Handle portion **40** is permanently attached to one end of body portion **42** and is provided with a grip portion **44** that is attached approximately perpendicular to body portion **42** to aid in inserting and de-installing the locking strap **16**. Body portion **42** has a first reduced thickness area **46** at a handle end **48** and a second reduced thickness area **50** at forward insertion end **52**. Reduced thickness areas **46**, **50** have half the cross section width of the full section of the remainder of the locking strap **16**. This reduction of the cross section enables the overlapping of the ends **48**, **52** of the locking strap **16** to bear the load of the entire circumference of the engagement between the locking strap **16** and the mating locking strap groove **30** and locking strap recess **36**. This is necessary because when the locking strap **16** passes through the slot **54** of the coupler **12** and into the locking strap passageway, there would be a loss of engagement with a portion of the passageway. To eliminate this loss of engagement and to construct a stronger joint, the reduced spline cross section enables the overlap of the ends of the spline. The performance of ultimate tensile pull increases by as a result.

The coupling assembly is also provided with an annular sealing member, such as annular sealing seal **18**. Seal **18** is has an upper surface **56** and a lower surface **58** and is generally

rectangular in cross-section. Both the upper surface **56** and lower surface **58** are provided each with three sealing lobes **60**. Each sealing lobe **60** forms a separate sealing surface when seal **18** is installed in the coupling assembly as compared to only one sealing surface if a seal with another cross-section, such as circular or rectangular, was used. The cross-sectional dimensions of seal **18** are small, approximately .200 inches by .122 inches in the most preferred embodiment but other dimensions could be used, enabling the load bearing pipe wall thickness to be maximized due to the multiple sealing lobes, without compromising sealing functionality. The minimized cross-sectional dimensions of seal **18** also allow seal groove **28** to be shallow, allowing for a thicker pipe wall **72** and the resultant increase in tensile strength of the pipe joint. This is critical because the seal groove **28** is one of the weakest areas of the pipe joint in pure tensile strength loading.

If a circular cross-sectional seal was used, as in similar competing products, and the wall thickness of the coupling remained the same, the diameter of the pipe would have to increase. This would require that a larger hole be drilled in the earth resulting in increased installation costs due to increased incremental drilling time and labor. The OD of the pipe coupling in the most preferred embodiment is nominally 5.0 inches and could be less compared to 5.5 to 6.0 inches of prior art coupled pipe designs.

Moreover, if the circular cross sectional seal was used, the insertion force would increase, requiring the use of tools to assemble the pipe joint. Insertion forces for the coupling of this invention are about a fourth of what it would be if a circular cross sectional seal were used thus enabling the joint to be assembled without tools. In the event disassembly of the joint is required, the low compression and drag of the seal **18** on the pipe allow disassembly of the joint without tools.

To assemble the pipe coupling, seal **18** is placed into seal groove **28** of coupler **12** of a first tube. Tubular component **14** of a second tube is then inserted into coupler **12** of the first tube. Tubular component **14** is inserted until chamfered surface **38** rests against the inner surface of curved transition region **24**. Seal **18** does not provide too much resistance during the insertion of tubular component **14** because of its reduced cross-sectional dimensions but forms an effective seal due to its multiple lobes **60** pressing against the outer surface **34** of tubular component **14**. When fully inserted, chamfered surface **38** rests against the inner surface of curved transition region **24**. Locking strap recess **36** of tubular component **14** aligns with locking strap groove **30** of coupler **12** to form a locking strap passageway. Locking strap recess **36** may be provided wider than groove **30** to allow some degree of adjustability. The two pipes are now in position for locking. The forward end **52** of locking strap **16** is inserted through slot **54** on coupler **12.** Locking strap **16** passes through the slot **54** and is received into locking strap passageway. Locking strap **16** is completely inserted causing forward end **52** to overlap with handle end **48** and the handle **40** to abut against the outer surface **22** of coupler **12** creating a strengthened coupling.

If disassembly of the pipe coupling is needed, this can be accomplished without resort to tools. Handle **40** can be grasped to pull locking strap **16** out of locking strap passageway. Because of the slight adjustability of the pipe coupling due to the recess **36** being slightly wider than groove **30**, tubes on either side of the coupling can be moved away from the coupling and also due to the decreased cross-section of the seal, the pipe coupling can be separated.

The coupling assembly of this invention may be favorably used with pipes made from a variety of materials, including a metal or a thermoplastic or a thermoset plastic. For practical reasons this invention is particularly useful in pipes made from thermoset plastic materials, such as

ethylene, ethylene-propylene copolymers and others, but especially PVC. In principal, however, the coupling assembly may be conveniently used with thermoset plastic pipes.

Having described in detail the preferred embodiment of the present invention, it is to be understood that this invention could be carried out with different elements and steps. This preferred embodiment is presented only by way of example and is not meant to limit the scope of the present invention which is defined by the following claims.

What is claimed:

1. A coupling assembly for connecting sections of conduit together in a borehole comprising:

a first coupling member attached to an end of a first conduit, said first coupling member having an outer surface and a circumferential recess in said outer surface;

a second coupling member attached to an end of a second conduit and adapted for connection with said first coupling member, said second coupling member having an inner surface and an outer surface, said second coupling member having a circumferential groove in said inner surface and a slot in said outer surface, said slot positioned to provide access to said groove, whereby when said first coupling member and said second coupling member are in a connected state said groove aligns opposite said recess to form a passageway; and

a locking member adapted for insertion into said slot and into said passageway, said locking member providing resistence against forces tending to separate said first coupling member from said second coupling member when inserted in said passageway.

2. The coupling assembly according to claim 1 wherein said locking member includes a first reduced thickness area near a first end and a second reduced thickness area adjacent a second end so that said first end and said second end overlap when said locking member is fully inserted in said passageway.

3. The coupling assembly according to claim 2 wherein said locking member includes a handle adjacent said first end.

4. The coupling assembly according to claim 1 further comprising a second circumferential groove in said inner surface of said second coupling member and a sealing member adapted for positioning within said second groove when said first coupling member and said second coupling member are in a connected state.

5. The coupling assembly according to claim 4 wherein said sealing member includes a plurality of lobes on both an upper surface and a lower surface of said sealing member.

6. The coupling assembly according to claim 1 wherein said second coupling member has a belled region.

7. The coupling assembly according to claim 1 wherein said first coupling member has a tubular shape.

8. The coupling assembly according to claim 1 wherein said circumferential recess is wider than said circumferential groove.

9. A conduit for installation in a borehole comprising:

a first coupling member attached to a first end of said conduit, said first coupling member having an outer surface and a circumferential recess in said outer surface;

a second coupling member attached to a second end of said conduit and adapted for connection with a second conduit having a first coupling member with a recess in an outer surface, said second coupling member having an inner surface and an outer surface, said second coupling member having a circumferential groove in said inner surface and a slot in said outer surface, said slot positioned to provide access to said groove, whereby when said second coupling member is in a connected state with said first coupling member of said second conduit said groove aligns opposite said recess in said second conduit to form a first passageway and

a locking member adapted for insertion into said slot and into said first passageway, said locking member providing resistence against forces tending to separate said conduit section from said second conduit when inserted in said first passageway.

10. The conduit according to claim 9 wherein said locking member includes a first reduced thickness area near a first end and a second reduced thickness area at a second end so

that said first end and said second end overlap when said locking member is fully inserted in said passageway.

11. The conduit according to claim 10 wherein said locking member includes a handle at said first end.

12. The conduit according to claim 9 further comprising a second circumferential groove in said inner surface of said second coupling member and a sealing member adapted for positioning within said second groove when said conduit and said second conduit are in a connected state.

13. The conduit according to claim 12 wherein said sealing member includes a plurality of lobes on both an upper surface and a lower surface of said sealing member.

14. A method of assembling conduits in a borehole comprising the steps of:

providing to said borehole a first conduit having a first coupling member, a second conduit having a second coupling member, a sealing member, and a locking member, said first coupling member having an outer surface and a circumferential recess in said outer surface, said second coupling member adapted for connection with said first coupling member and having an inner surface and an outer surface, said second coupling member having a first circumferential groove in said inner surface, a second circumferential groove in said inner surface, and a slot in said outer surface, said slot positioned to provide access to said first groove, whereby when said first coupling member and said second coupling member are in a connected state said first groove aligns opposite said recess to form a passageway, said locking member adapted for insertion into said slot and into said passageway, said sealing member adapted for positioning within said second groove when said first coupling member and said second coupling member are in a connected state;

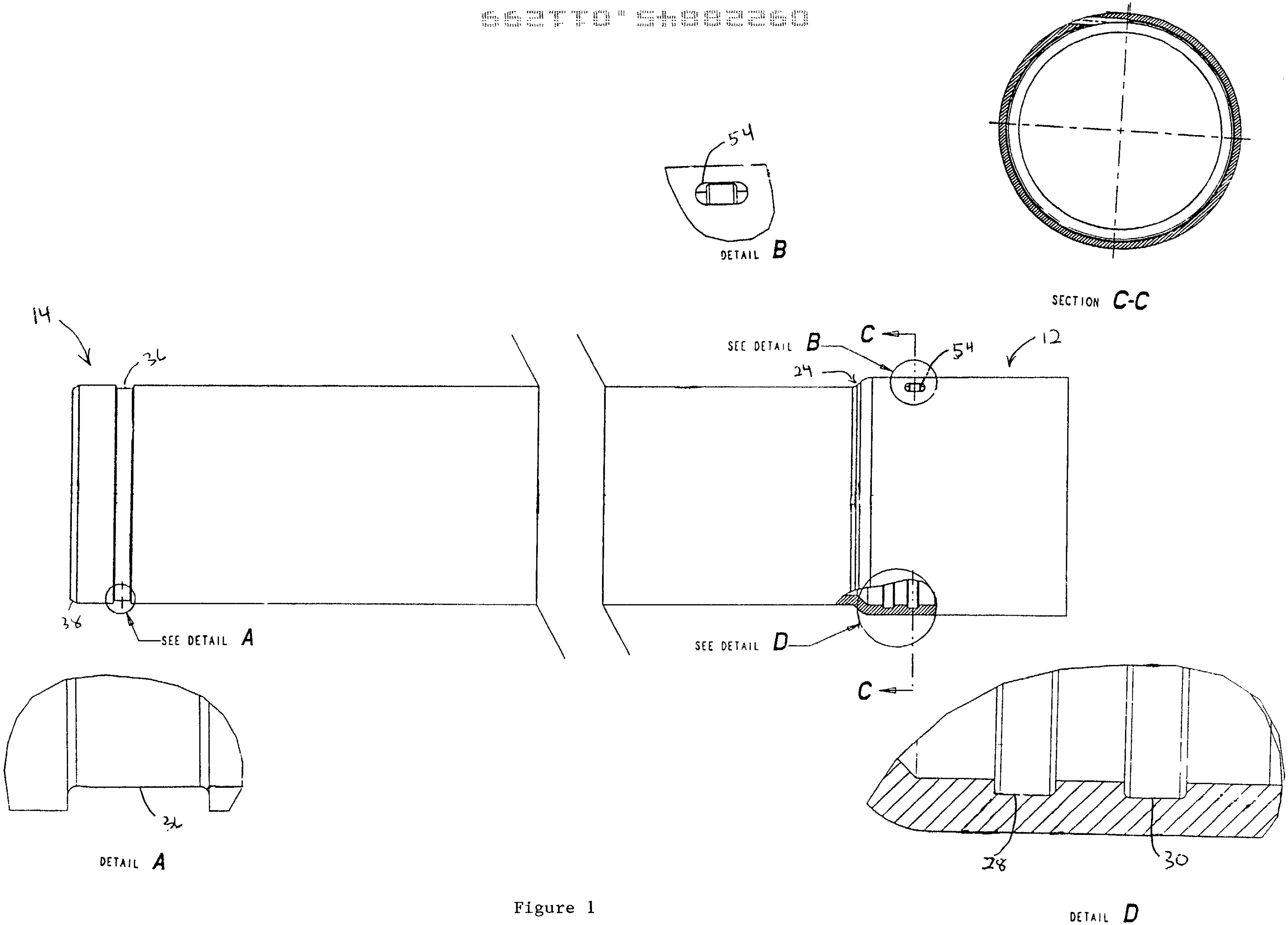
connecting said first coupling member to said second coupling member; and

installing said locking strap into said passageway.

15. The method according to claim 14 wherein said sealing member includes a plurality of lobes on both an upper surface and a lower surface of said sealing member.

ABSTRACT OF THE DISCLOSURE

A coupling assembly for conduit or pipe comprising a first coupling member, a second coupling member and a locking member. The first coupling member is optionally a tubular component and the second coupling member or coupler is optionally a belled component. The present invention is also optionally provided with an annular sealing member.



DETAIL B
54
SECTION C-C
14
36
38
SEE DETAIL A
SEE DETAIL B
C
24
12
SEE DETAIL D
C
DETAIL A
DETAIL D
28
30

Figure 1

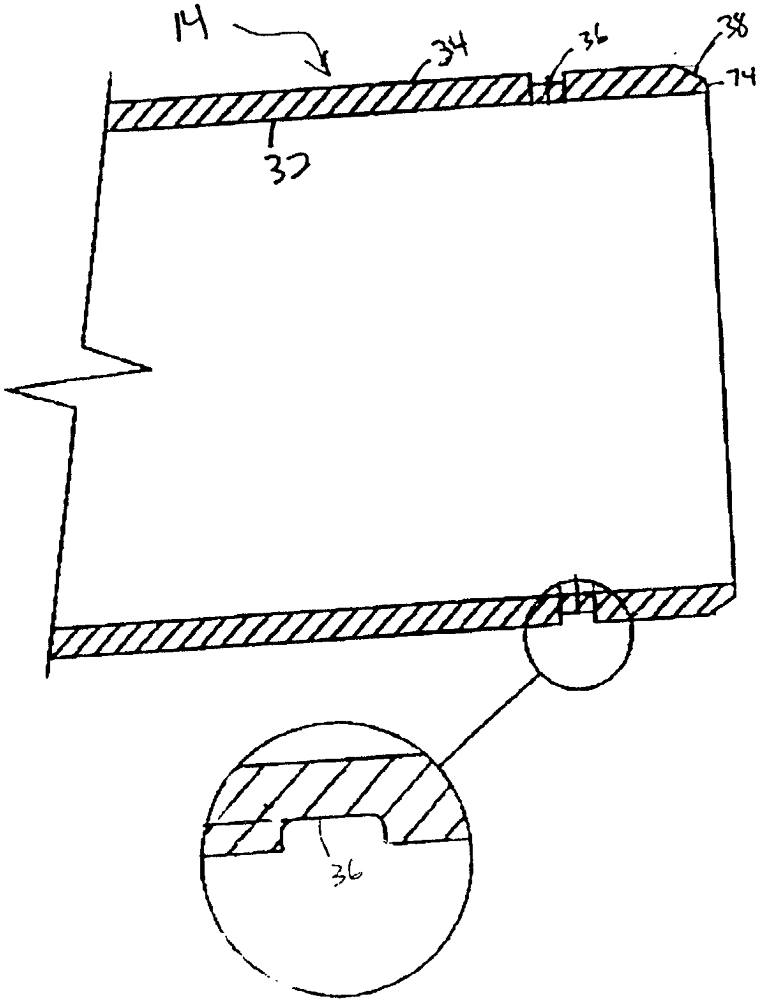


Figure 6

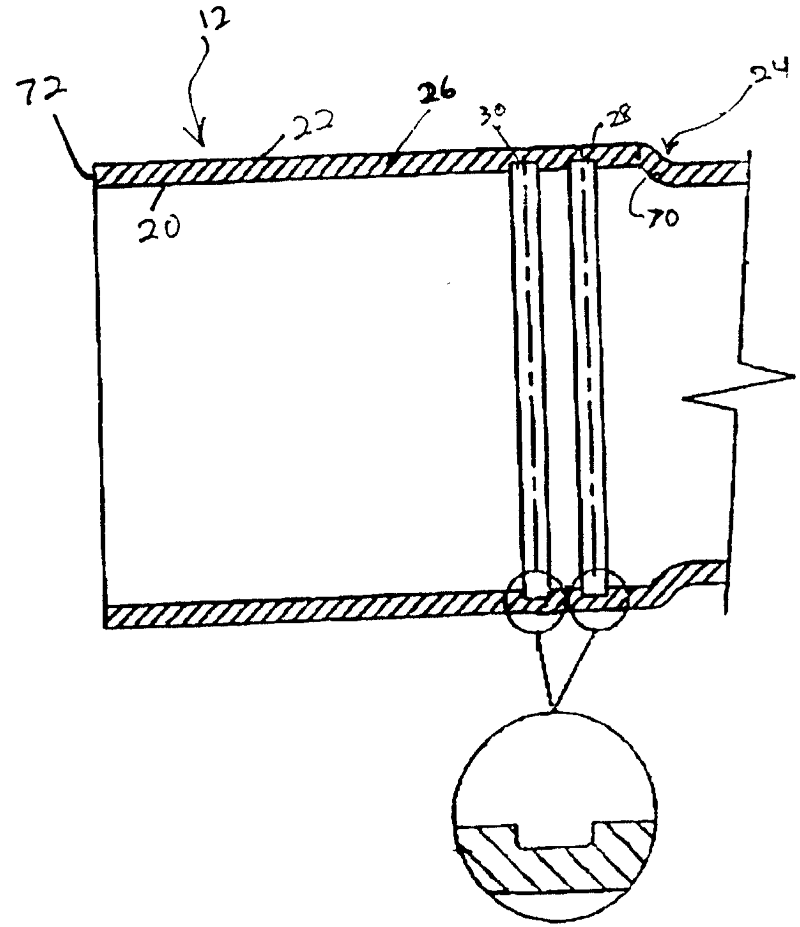


Figure 2

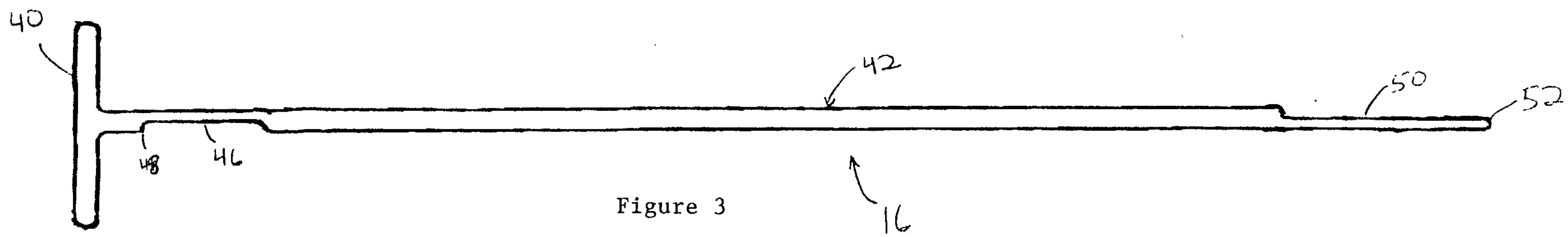


Figure 3

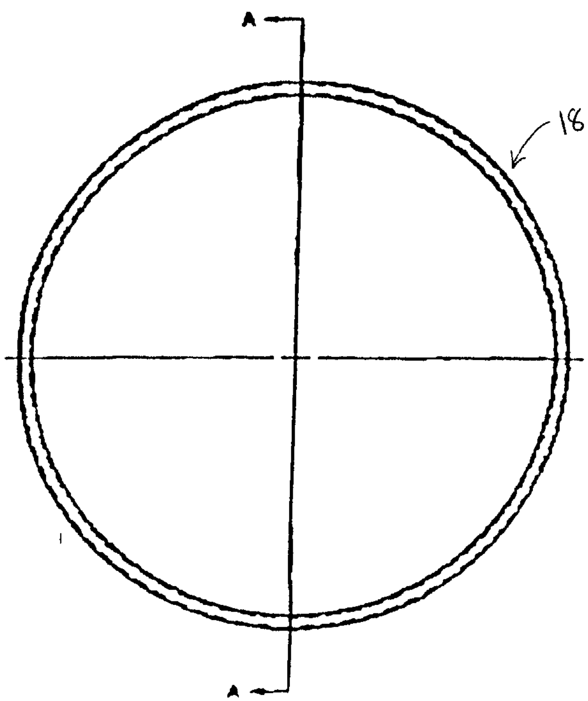
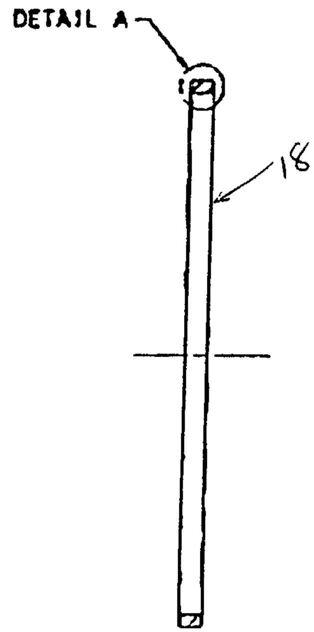
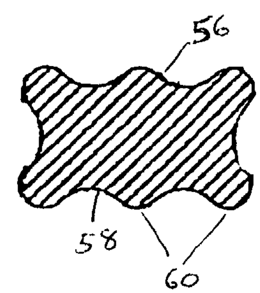


Figure 4A



SECTION A-A
Figure 4B



DETAIL A

Figure 4C

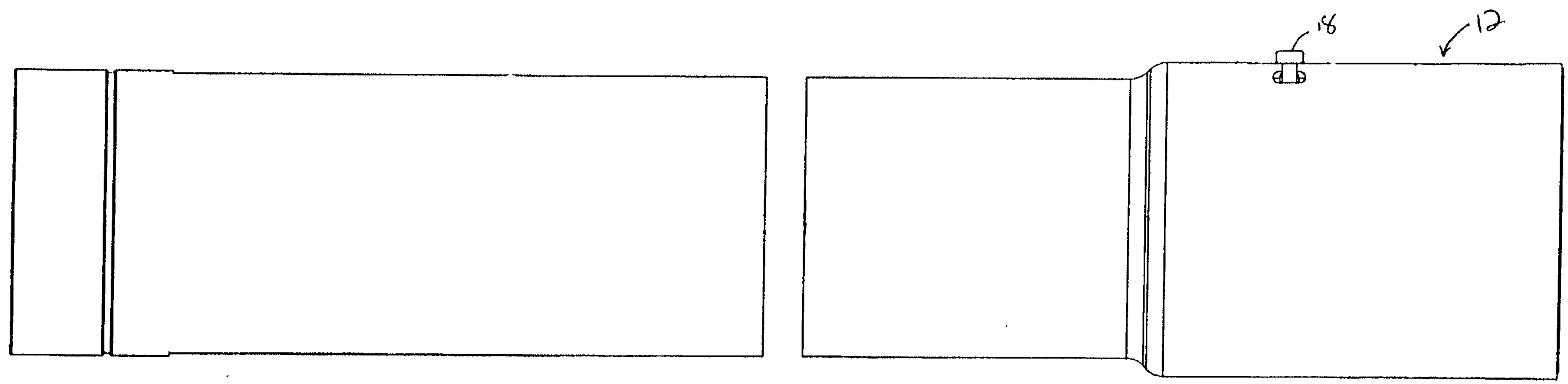


Figure 5

DECLARATION AND POWER OF ATTORNEY
(Joint Inventors)

We, Paul Metcalfe, Craig A. Homberg, and Walter G. Lockard, hereby declare that we are, respectively,

a citizen of the United States, residing at 35235 Quartermane Circle, Bentleyville Village, Solon, Ohio 44139-2469;

a citizen of the United States, residing at 1617 Chestnut Blvd., Cuyahoga Falls, Ohio 44223;

a citizen of the United States, residing at 147 Hudson Street, Hudson, Ohio 44236;

that we have reviewed and understand the content of the attached specification, including the claims (Jones, Day, Reavis & Pogue Docket No. 427600800004), and we believe that we are the original, first, and joint inventors of the subject matter which is claimed therein and for which a patent is sought on the invention or discovery entitled

COUPLING ASSEMBLY HAVING ENHANCED AXIAL TENSION
STRENGTH AND METHOD OF INSTALLATION OF
COUPLED UNDERGROUND DUCT

and that we acknowledge our duty to disclose information of which we are aware which is material to the examination of this application, in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

We hereby claim the benefit under 35 U.S.C. 119(e) of United States Provisional Application Serial No. 60/071,159 filed January 12, 1998.

We hereby designate the following as our mailing address and telephone number:

F. Drexel Feeling, Esq.
Jones Day, Reavis & Pogue
North Point
901 Lakeside Avenue
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(216) 586-3939

and appoint each of the following as our attorneys with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

F. Drexel Feeling; Registration No. 40,602; Kenneth R. Adamo, Registration No. 27,299; Barbara Arndt, Registration No. 37,768; David B. Cochran, Registration No. 39,142; Cheryl L.

Farine, Registration No. 36,796; Regan J. Fay, Registration No. 26,878; Calvin P. Griffith, Registration No. 34,831; Paul V. Keller, Registration No. 42,713; David M. Maiorana, Registration No. 41,449; Timothy J. O'Hearn, Registration No. 31,552; Jay Ryan, Registration No. 37,064; Stephen D. Scanlon, Registration No. 32,755; Barry L. Springel, Registration No. 25,514; H. Duane Switzer, Registration No. 22,431; Michael W. Vary, Registration No. 30,811; and James L. Wamsley, III, Registration No. 31,578

all having the above-designated address.

We further declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date 1-8-99

Paul Metcalfe

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Date 1-8-99

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Walter G. Lockard Date January 8, 1999

Walter G. Lockard

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